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U.S. Bureau of
Reclamation

Irrigation projects of the
U.S. Reclamation Service

[Washington]

[1919]

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DEPARTMENT OF THE INTERIOR
U. S. RECLAMATION SERVICE

IRRIGATION PROJECTS

OF THE U. S. RECLAMATION SERVICE



CONCONULLY RESERVOIR IN OKANOGAN NATIONAL FOREST, WASHINGTON

NATIONAL RECLAMATION OF ARID LANDS

DEPARTMENT OF THE INTERIOR
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NATIONAL RECLAMATION OF ARID LANDS



THE DESERT BEFORE RECLAMATION.



THE DESERT RECLAIMED

(2)

REVISED TO NOVEMBER 1, 1920.

IRRIGATION PROJECTS.

For convenience in answering the inquiries of the public generally regarding the irrigation projects of the United States Reclamation Service, and concerning irrigable lands which eventually will be reclaimed, the following brief statement is published in circular form. Detailed information as to areas open to settlers may be obtained by addressing the Statistician of the Reclamation Service, Washington, D. C.

Accompanying this booklet is a tabulated statement showing the reclamation projects which contain Government land open to entry at the present time, the number of farm units available, cost of water rights, etc.

ARIZONA, SALT RIVER PROJECT.

The Salt River project, one of the first undertaken by the Government under the reclamation law, is completed and was turned over on November 1, 1917, to the Salt River Valley Water Users' Association for operation and maintenance by the water users. The Government retains a lien on the lands subscribed for water-right charges, but the administration of the irrigation system is in the hands of the association, to which inquiries may be addressed at Phoenix, Ariz.

The lands under this project surround Phoenix, the capital of the State, and are situated in Maricopa and Gila Counties. The general elevation is 1,000 to 1,300 feet above sea level; the temperature ranges from 22° to 117° F. and the rainfall from 3 to 10 inches. The watershed area of the Salt River is 6,250 square miles, and that of the Verde River 6,000 square miles. The average annual rainfall on the watershed area is from 10 to 20 inches, and the estimated average run-off is 865,000 acre-feet from the Salt River at Roosevelt Dam and 500,000 acre-feet from the Verde.

The valley is traversed by the Santa Fe and Southern Pacific Railroads, which connect it with the towns of the State, the Pacific coast cities, and eastern markets. The railroad stations and other towns are Phoenix, Mesa, Glendale, Tempe, Chandler, Peoria, Gilbert, Scottsdale, Higley, Lehl, and Tolleson.

The soil is an alluvial deposit of high fertility, adapted to the growth of a wide variety of crops, including those of the temperate and semitropical zones. The agricultural year is divided in two seasons, a summer season commencing June 1 and ending September 30, devoted to the cultivation of alfalfa, garden truck, sorghum, cereals, small fruits, cantaloupes, melons, etc., and a winter season commencing October 1 and ending May 31 of the following year, devoted principally to the cultivation of alfalfa, cereals, and citrus fruits. Irrigation is carried on throughout the whole year. The growing of the long-fiber Egyptian cotton has become a very important industry. Another leading industry is dairying, which is carried on throughout the entire year.

All the lands in the project have been filed upon and can be acquired now only by purchase from present owners. There has been a tendency toward the cutting up of the large farms into smaller holdings, and this policy is bringing new families into the valley who are making their homes on the land. There has been also a marked increase in the number of cooperative organizations, principally for the sale of produce. This is especially true of the Farmers' Union, which endeavors to market all the crops raised by the members, and of



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the organizations for the production and sale of cotton. There has been a marked increase in the acreage planted to intensive crops, especially cotton, of which a superior variety of long staple has been developed with success. During the season 1918-19 approximately 66,000 acres of cotton yielded a gross return of \$210 per acre. For all crops that season the association reported a gross value of \$23,708,681 for 188,232 acres cropped, or \$126.27 per acre. Approximately 205,000 acres were irrigated.

Included among the project works is the Roosevelt Dam, which creates a reservoir with a storage capacity of 1,305,000 acre-feet. Roosevelt Dam is of rubble masonry 280 feet high, 235 feet long on the bottom, and 1,125 feet long on top. Its purpose is to regulate the flow of Salt River and store the water for future needs. When required for irrigation the water is allowed to flow down the river channel from the dam for 40 miles, and is then diverted by the Granite Reef Dam into two canals, one on each side of the river, which carry it to the irrigable lands. This diversion dam is a rubble concrete weir 38 feet high and 1,000 feet long. The distribution system includes 850 miles of canals and laterals.

There have been completed and put into operation 47 pumping plants, with a discharge ranging from 1½ to 10 second-feet. A pumping plant located at the junction of the Western Canal and Kyrene branch pumps water through a 54-inch pressure pipe 5,930 feet long to an elevation of 40 feet and waters approximately 7,500 acres of land.

A power plant located at Roosevelt generates power from stored water in the reservoir and other hydroelectric power plants, the South-Consolidated, the Arizona Falls, the Cross Cut, and the Chandler, have been built to take advantage of the opportunities created by the canal system. A portion of the power developed is used for pumping water for irrigation, and the remainder for industrial purposes.

ARIZONA-CALIFORNIA, YUMA PROJECT.

The Yuma project is planned to irrigate about 114,000 acres of land lying in Yuma County, Ariz., and Imperial County, Calif. The irrigable area is divided in three units—the Yuma Indian Reservation, comprising some 16,000 acres, 6,500 of which were opened to white settlers in 1910, the balance being divided in 10-acre units for the Indians; the Yuma Valley, comprising about 53,000 acres; and the mesa lands, comprising 45,000 acres. The irrigation system is completed to a point where it will serve 70,000 acres. The power and pumping plants and the distribution system for the mesa unit have been designed, and construction has been started. This unit of the project is provided for in the Yuma Mesa act of January 25, 1917, which provides for the sale of the lands and makes the proceeds available for the construction of the irrigation works. The sale of lands in the first unit of the Mesa was opened on December 10, 1919.

This project has a year-round growing season, a productive soil, and an ample water supply. The irrigable area is from 80 to 215 feet above sea level; the temperature ranges from 22° to 118° F. The soil of the valleys is a rich alluvium, and of the mesa, Fresno gravelly sand. The annual rainfall is about 2.5 inches. The watershed area is 225,000 square miles, and the mean annual run-off is 17,000,000 acre-feet.

Excluding the mesa, the cost of water right is \$55, \$66, \$75, and \$90 per acre. The returns per acre from crops in 1919 amounted to \$134. Cotton is the principal crop in the bottom lands, and alfalfa hay and seed are valuable products. Grains, vegetables, citrus fruits, dates, olives, cane, corn, etc., are or can be grown. The limit of public land farms is 40 acres.



HARVESTING BARLEY IN THE YUMA VALLEY, ARIZ.

The Southern Pacific Railroad which crosses the project at Yuma furnishes transportation facilities to Arizona towns, the Pacific coast, and eastern markets. The project towns are Yuma, Potholes, Winterhaven, Somerton, and Cadsden. In 1914 and 1915 the Government constructed about 26 miles of standard-gauge railroad, extending from Yuma along the Colorado levee to the international boundary, which is the southern terminus. The primary purpose of the railway is to protect the levees, but passengers and farm products are being carried.

This project involves the diversion of the waters of the Colorado River by means of Laguna Dam, a structure of the Indian weir type, about 10 miles north of Yuma, Ariz. This dam was completed in March, 1909. It is about 10 feet high, 4,780 feet long, and 260 feet wide up and down stream. By a unique arrangement at the head gates of the canals the waters of this muddy stream are drawn off comparatively clear. A siphon 930 feet long, with a capacity of 1,400 cubic feet per second, has been constructed under the Colorado River at Yuma to carry water from the main canal in California to the bottom lands of the Yuma Valley in Arizona. Irrigation water was turned through this siphon on June 29, 1912. The distribution system consists of 325 miles of canals.

A system of levees protects the bottom lands from overflow of the Colorado River. Forty-three miles of levee have been constructed and are being maintained.

A drainage system for the reservation unit is partially completed, which requires a pumping system to remove the surplus water during high stages of the Colorado River. For the Yuma Valley unit, a drainage system is under construction; this requires a pumping plant at the boundary, and on December 31, 1919, the pumping plant and 18 miles of main drain were completed.

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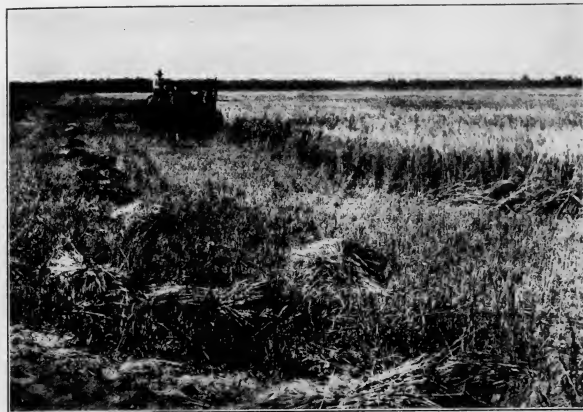
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ALMOND ORCHARD, ORLAND PROJECT, CALIF.

CALIFORNIA, ORLAND PROJECT.

This project was constructed for the reclamation of 20,000 acres of land lying about 100 miles north of Sacramento in Glenn and Tehama Counties. The transportation lines are the Southern Pacific Railroad and steamers on the Sacramento River. The project is centrally traversed from north to south by a concrete State highway, which is connected by good roads with all parts of the project. The State highway extends from the north to the south boundary of the State and with its laterals reaches all principal cities and towns. The principal town of the project is Orland, which in 1920 had a population of 1,600. Greenwood, Wyo., and Malton, flag stations on the railroad, are also shipping points. Within the project are ten public schools. All parts of the project are reached by telephone, and some of the rural districts are served with electricity for power and lighting purposes.

The lands, which are practically all in private ownership, are exceedingly fertile. The soil is a gravelly loam, and sandy and silt loam, and with irrigation and the prevailing climatic conditions it has been demonstrated that the land is excellent for the production of numerous crops, including alfalfa, almonds, English walnuts, and both citrus and deciduous fruits. The general elevation is 250 feet above sea level, the temperature ranges from 26° to 114° F., and the average annual rainfall is about 17 inches. The drainage basin covers about 900 square miles. The average annual rainfall on the drainage basin is 25 inches, and the estimated annual run-off on the watershed is 541,000 acre-feet.

The project was opened by public notice May 24, 1916, with a building cost of \$44 per acre. Through a petition and vote of the water users in 1917, \$11 per acre was provided for supplemental construction, this amount to be used for lining the canals and laterals with concrete.

A great many fine dairy cows have been brought in by the creamery companies, banks, and others interested in the development of the industry, and placed with farmers on easy terms of payment. Two creameries handle all of the butter product, which averages about 4 tons daily. The dairymen are organized into testing and breeding associations. The almond and orange growers are affiliated with associations through which their crops are marketed. The chicken business also has assumed considerable importance, being represented in 1919 by an investment of \$75,000. The tendency here, as on most of the projects, is toward small farms intensively cultivated, and the larger holdings have been cut up into small tracts and sold to actual settlers. In 1919 about 16,000 acres had been developed, with an average of 30 acres in each farm.

The irrigation plan of the Orland project provides for the storage of water in a reservoir controlled by East Park Dam on Little Stony Creek, about 40 miles southwest of Orland, Calif., and a feed canal 7 miles long connecting the storage basin with Stony Creek. The diversion works for the feed canal are located about 3½ miles west of Stonyford. For the irrigation of lands in the vicinity of Orland water is diverted from Stony Creek into the canal systems at two points, namely, Miller Buttes, 9½ miles northwest of Orland, for the South Canal system, and at the north side weir, 5 miles northwest of Orland, for the North Side Canal system. The South Canal system irrigates 13,000 acres on the south side and the North Canal system 7,000 acres on the north side of Stony Creek. The stored water is conveyed from East Park in the natural creek channel 41 miles to the Miller Buttes diversion and 45 miles to the north side weir, where it is taken out in distribution systems comprising 140 miles of canals and laterals. The plan also includes a high-line canal from which power may be developed for pumping.

The present limits of the Orland project may be considered as a unit of the Sacramento Valley project. It may be extended by constructing additional reservoirs on Stony Creek and its tributaries. The chief additional reservoir sites are Millsite, on Stony Creek, near Fruto, and Stony Gorge, on Stony Creek, near Elk Creek.

COLORADO, GRAND VALLEY PROJECT.

The Grand Valley is located in the plateau region on the western slope of the Rocky Mountains in western Colorado. The irrigable area of the Grand Valley project includes 50,000 acres of land, lying above the old irrigated district on the north side of the valley, 40,000 acres of which will be supplied by gravity canals and 10,000 acres by electrically operated pumping plants lifting water from the main canal. Water is also supplied through the project system for 8,400 acres in the Palisade and Mesa County irrigation districts.

The source of the water supply is the natural flow of the Grand River, the largest stream in Colorado, from which the water is diverted, by means of a diversion dam located in the canyon 8 miles above Palisade, Colo., into a main canal 62 miles in length. The average elevation of the project is 4,700 feet above sea level. The temperature ranges from -15° to 100° F., and the annual rainfall is about 8.5 inches. The climate is mild, with a large percentage of sunshine and long growing season.

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purchase of relinquishment of deed from present owners. The average size of the farms is about 60 acres.

The principal crops produced on the project are alfalfa, wheat, oats, sugar beets, corn, potatoes, fruit, and vegetables. Apples, pears, and peaches are grown successfully in parts of the valley. The crop return in 1919 averaged \$64.12 per acre. The soil consists of three general types—red sandy mesas, sandy loam, and adobe. The red soils are deep and well drained and especially adapted to the growing of fruits, and also for alfalfa, corn, and potatoes. The sandy loam is an alluvial soil, very fertile, and adapted to the growing of practically all kinds of crops. The adobe soils are heavier and are especially adapted for sugar beets and cereals.



YOUNG ORCHARD NEAR GRAND JUNCTION, COLO.

The Denver & Rio Grande Railroad connects the valley with the markets of the Mississippi Valley and the Atlantic and Pacific coasts. The principal railroad shipping points are Grand Junction, Fruita, Loma, Mack, Palisade, and Clifton, all adjacent to or on the project. An electric interurban line serves the portion of the project between Grand Junction and Fruita. The sugar factory at Grand Junction furnishes a market for all sugar beets grown on the project and the local flour mill for wheat and other cereals; local canneries handle each year a large quantity of tomatoes, fruits, and vegetables. The marketing of the fruit crop is handled largely through cooperative associations. The educational facilities are excellent on account of the proximity of the project to the old settled-up district.

The engineering works include the Grand River diversion dam and 62 miles of main canal, including 2½ miles of concrete-lined tunnels and a number of

reinforced concrete siphons. Future plans provide for the installation of a hydroelectric power plant to provide power for pumping to the lands above the gravity canal. The diversion dam is of the roller crest type, consisting of a concrete weir, upon which are placed seven movable crests consisting of large steel rollers. During the low-water period the rollers are lowered to divert the water into the main canal, and at times of flood they are rolled up on pliers to permit the high water to pass without damaging the adjacent railroad.

COLORADO, UNCOMPAGHRE PROJECT.

Surrounding the towns of Montrose and Olathe, in Montrose County, and Delta, in Delta County, on the western slope of the Rocky Mountains, lie 100,000 acres of rich bottom and mesa lands comprising the Uncompahgre project. The works for the delivery of water to the entire area are practically complete. The farm units vary in size from 40 to 80 acres. The heavier soils are especially well adapted to the raising of sugar beets and wheat. The entire area is adapted to alfalfa, wheat, and oats, and considerable areas to the raising of potatoes and onions. The range in soil from heavy adobe to light, sandy loam makes possible a wide diversity of profitable crops.

The principal markets are the local mining camps and Denver, although large quantities of apples, potatoes, and onions are shipped to eastern markets. In 1919, 59,746 acres were cropped, producing an average return of \$56.76 per acre. The farmers are progressive and have splendid schools and farmers' organizations. Practically the entire project is reached by telephone and rural free delivery and a considerable part of it by the power lines of a local power company. During the past two years the farmers, cooperating with the county commissioners, graveled 20 miles of road and are considering the graveled of many additional miles.

The irrigable land lies between the elevations of 5,000 and 6,400 feet above sea level. The temperature ranges from 25° below to 96° above zero. The rainfall on the irrigable land is 6 to 12 inches. The Denver & Rio Grande Railroad traverses the tract, with stations at Montrose, Olathe, and Delta.

The valley is protected on the north by Grand Mesa, on the east by Vernal Mesa, on the south by the San Juan Mountains, and on the west by the Uncompahgre Plateau. Practically all of the surrounding mountainous area is included in Forest Reserves and makes excellent range for live stock.

The engineering work involved the diversion of the waters of the Gunnison River by means of a tunnel 30,645 feet long, with a cross section 10½ by 11½ feet, concrete lined where necessary, with a capacity of 1,000 cubic feet per second. The tunnel passes 2,200 feet below the summit of Vernal Mesa and carries the water to the Uncompahgre Valley, where it is used to supplement the flow of the Uncompahgre River and is diverted to eight lateral systems supplying the project.

IDAHO, BOISE PROJECT.

The Boise project has reclaimed 143,000 acres of sage-brush land, and in addition supplies storage water to 130,000 acres of old water-right land; contemplated extensions will cover 50,000 acres more of dry land. The project is located in the Boise and Snake River Valleys, in Ada and Canyon Counties in southwestern Idaho and Malheur County in eastern Oregon. The soil is clay loam and sandy loam, and the principal products are alfalfa, small grains, corn, clover seed, potatoes, apples, prunes, and small fruit.

purchase of relinquishment of deed from present owners. The average size of the farms is about 60 acres.

The principal crops produced on the project are alfalfa, wheat, oats, sugar beets, corn, potatoes, fruit, and vegetables. Apples, pears, and peaches are grown successfully in parts of the valley. The crop return in 1919 averaged \$64.12 per acre. The soil consists of three general types—red sandy mesas, sandy loam, and adobe. The red soils are deep and well drained and especially adapted to the growing of fruits, and also for alfalfa, corn, and potatoes. The sandy loam is an alluvial soil, very fertile, and adapted to the growing of practically all kinds of crops. The adobe soils are heavier and are especially adapted for sugar beets and cereals.



YOUNG ORCHARD NEAR GRAND JUNCTION, COLO.

The Denver & Rio Grande Railroad connects the valley with the markets of the Mississippi Valley and the Atlantic and Pacific coasts. The principal railroad shipping points are Grand Junction, Fruita, Loma, Mack, Palisade, and Clifton, all adjacent to or on the project. An electric interurban line serves the portion of the project between Grand Junction and Fruita. The sugar factory at Grand Junction furnishes a market for all sugar beets grown on the project and the local flour mill for wheat and other cereals; local canneries handle each year a large quantity of tomatoes, fruits, and vegetables. The marketing of the fruit crop is handled largely through cooperative associations. The educational facilities are excellent on account of the proximity of the project to the old settled-up district.

The engineering works include the Grand River diversion dam and 62 miles of main canal, including 2½ miles of concrete-lined tunnels and a number of

reinforced concrete siphons. Future plans provide for the installation of a hydroelectric power plant to provide power for pumping to the lands above the gravity canal. The diversion dam is of the roller crest type, consisting of a concrete weir, upon which are placed seven movable crests consisting of large steel rollers. During the low-water period the rollers are lowered to divert the water into the main canal, and at times of flood they are rolled up on piers to permit the high water to pass without damaging the adjacent railroad.

COLORADO, UNCOMPAGHRE PROJECT.

Surrounding the towns of Montrose and Olathe, in Montrose County, and Delta, in Delta County, on the western slope of the Rocky Mountains, lie 100,000 acres of rich bottom and mesa lands comprising the Uncompahgre project. The works for the delivery of water to the entire area are practically complete. The farm units vary in size from 40 to 80 acres. The heavier soils are especially well adapted to the raising of sugar beets and wheat. The entire area is adapted to alfalfa, wheat, and oats, and considerable areas to the raising of potatoes and onions. The range in soil from heavy adobe to light, sandy loam makes possible a wide diversity of profitable crops.

The principal markets are the local mining camps and Denver, although large quantities of apples, potatoes, and onions are shipped to eastern markets. In 1919, 50,746 acres were cropped, producing an average return of \$56.76 per acre. The farmers are progressive and have splendid schools and farmers' organizations. Practically the entire project is reached by telephone and rural free delivery and a considerable part of it by the power lines of a local power company. During the past two years the farmers, cooperating with the county commissioners, graveled 20 miles of road and are considering the graveling of many additional miles.

The irrigable land lies between the elevations of 5,000 and 6,400 feet above sea level. The temperature ranges from 25° below to 98° above zero. The rainfall on the irrigable land is 6 to 12 inches. The Denver & Rio Grande Railroad traverses the tract, with stations at Montrose, Olathe, and Delta.

The valley is protected on the north by Grand Mesa, on the east by Vernal Mesa, on the south by the San Juan Mountains, and on the west by the Uncompahgre Plateau. Practically all of the surrounding mountainous area is included in Forest Reserves and makes excellent range for live stock.

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Dairying is an important and a rapidly growing industry. A large milk condensery has been constructed recently at Nampa by the Carnation Milk Products Co.

Trolley lines have been extended from the principal towns to cover portions of the valley. The Oregon Short Line Railroad runs through the project, with three branch lines out of Nampa extending through the project. The project towns are Boise, Nampa, Caldwell, Meridian, Kuna, Bowmont, Melba, and Wilder.

The general elevation of the project is 2,500 feet above sea level. The temperature rarely goes below zero or above 100°. The winters are generally mild and free from wind. The summers are long, sunny, and warm, and with irrigation plant growth is rapid. Four cuttings of alfalfa are common.

The source of water supply is the Boise River, which has a drainage area of 2,610 square miles, and the mean annual run-off is 2,515,000 acre-feet.

The principal engineering works are as follows: Arrowrock Dam and Reservoir—the highest dam in the world, height from foundation 349 feet, length 1,100 feet, and reservoir capacity of 280,000 acre-feet; a diversion dam, 8 miles above Boise, where the Main Canal (capacity 2,500 second-feet) diverts from the Boise River; a three-unit hydroelectric plant at the diversion dam (capacity 2,500 horsepower), which furnished power for the construction of Arrowrock Dam, and is now leased for commercial purposes; the Deer Flat Reservoir near Caldwell, with a capacity of 177,000 acre-feet; and 1,000 miles of canals and laterals.

The Boise project was put under public notice by the Secretary of the Interior on July 2, 1917.



ARROWROCK DAM, BOISE PROJECT, IDAHO.

(10)

IDAHO, KING HILL PROJECT.

This project contemplates the reclaiming of 16,200 acres of land lying in the Snake River Valley in Elmore, Gooding, Owyhee, and Twin Falls Counties. The soil ranges from light to heavy sandy loam and the principal products are alfalfa, early vegetables, grain, fruit, and stock. The value of the crop produced in 1919 averaged \$55.39 per acre. The King Hill Fruit Growers' Association assists the farmers in selling the produce of the project. They own their own warehouse at King Hill and handle the purchase of the necessary potato sacks, spraying material, crates, boxes, etc.

The Oregon Short Line Railroad traverses the tract and furnishes transportation facilities. It passes through the towns of Bliss, King Hill, Glenns Ferry, and Hammett. The principal markets are Portland, Butte, Boise, and the small towns in southeastern Idaho.

The average elevation of the irrigable land is 2,750 feet above sea level, and the temperature ranges from 17° below zero to 111° F. above, although it rarely goes below zero. The summers are long, sunny, and warm, and with irrigation, promote rapid vegetable growth.

The source of water supply is Malad River. This river for several miles above the diversion is supplied by springs which yield more than 1,000 second-feet in the late summer and the project has the prior water right to 300 second-feet. The length of the irrigation season is 193 days, from April 1 to October 10. The annual average rainfall for the past eight years is 9.35 inches.

The irrigation plan of the King Hill project provides for the diversion of water from the Malad River into a flume of the Idaho Power Co. at a point about 1 mile above the junction of the Malad and Snake Rivers. The water is carried 4,000 feet through a flume in the canyon of the Malad and then divided between the King Hill Canal and the Malad power plant. The King Hill main canal is 48 miles in length and with its laterals involves 4 bridges and siphons across the Snake River. Twenty-nine per cent of the length of the main canal consists of structures or concrete-lined sections.

Most of the land on this project has either been filed on or is held in private ownership, although good farms may be purchased at reasonable prices from the settlers.

IDAHO, MINIDOKA PROJECT.

The Minidoka project contains 121,500 acres, is located in south central Idaho, in Cassia and Minidoka Counties, and lies on both sides of the Snake River. The gravity system covers 72,500 acres, and the south side pumping unit 49,000 acres.

On the gravity unit the soil varies from sand and sandy loam to clay loam. On the pumping unit it is what is locally called disintegrated lava ash, which is similar to a sand loam. The soil and climate are adapted to the raising of alfalfa, potatoes, sugar beets, clover seed, and small grains. The principal markets are Salt Lake, Portland, and Kansas City. There has been a rapid improvement in economic conditions and farming methods. Seventy per cent of the farmers have sheep on their ranches.

Over one thousand of the farms are receiving electric current from the Reclamation Service power system through mutual companies, which build and own the distributing systems. Electricity is being used for heating many of the buildings in the towns. This is a by-product of the power station that has been built for pumping water during the irrigation season.

The general elevation is 4,225 feet above sea level. The winters are usually mild.

(11)

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FARM SCENE ON MINIDOKA PROJECT, IDAHO

Water-right construction charges on the gravity unit are \$22, \$30, \$42, and \$56 per acre, and on the pumping unit are \$56.50 and \$57.50 per acre.

The engineering works include a diversion, power and storage dam on Snake River, about 7 miles south of Minidoka, two canal systems, one on each side of the river heading at the diversion dam, and three main pumping stations. Additional storage is provided in Jackson Lake, Wyo., and brought down Snake River at times when needed.

There are 634 miles of canals and 82 miles of transmission lines on the project. The tract is well supplied with railroad facilities by several branches of the Oregon Short Line.

A State highway crosses the project, and many surfaced feeder highways have been built, giving the project an excellent highway system.

The farms range in size from acreage tracts to 160 acres, and average about 50 acres. All of the desirable homestead land has been filed on, but good farms can frequently be purchased at reasonable prices.

Several enterprising towns have grown up on the project, among them being Burley with a population of 5,400, Rupert 2,400, Declo, Paul, Heyburn, and Arco. The educational institutions in both town and country are excellent. High schools are maintained at Burley, Rupert, and Heyburn. At Albion, about 9 miles from the project, is the State normal school.

There are two beet-sugar factories on the project, four flour mills, a potato dehydrating plant, three cheese factories, and several alfalfa mills, besides many smaller industries. There are also a large number of successful cooperative associations and enterprises.

MONTANA, HUNTLEY PROJECT.

This project contains 32,800 acres of irrigable land, located along the Yellowstone River in Yellowstone County.

The general elevation of this part of Montana is 3,000 feet above sea level. Its climate is delightful, and the soil varies from a heavy clay to a light sandy loam, producing abundant crops when properly watered. The principal products are alfalfa, forage, cereals, sugar beets, and vegetables.

The settlers are accumulating a large number of dairy cattle, hogs, and other stock. The dairy industry is increasing from year to year. There is a creamery at Worden, Mont., and a Farmers' Cooperative Cheese Factory at Ballantine, Mont., which are dependent upon the project for their supplies. In addition to this a considerable amount of sweet cream is shipped to Billings and to other cities in the State.

The farm units vary from 40 acres to 160 acres of irrigable land, and the cost of water right is \$30 to \$60 per acre. As the land is a part of the ceded strip of the Crow Indian Reservation settlers are required to pay \$4 per acre to the Indians. All of the desirable homestead lands have been entered.

Two transcontinental lines of railroad—the Northern Pacific and the Chicago, Burlington & Quincy—traverse the tract its entire length, and eight towns have been laid out at intervals so that no farm is more than 3 miles from a shipping point. The railroads furnish excellent transportation facilities to Chicago, St. Paul, Minneapolis, Omaha, Denver, and nearby cities.

Churches have been established at various points on the project. A consolidated school system is in operation, the children being taken to and from the schools in auto busses.

The principal towns are Huntley, Worden, Pompey's Pillar, and Ballantine.

MONTANA, MILK RIVER PROJECT.

The Milk River irrigation project contemplates the irrigation of about 192,000 acres of land in Blaine, Phillips, and Valley Counties. The irrigation plan provides for the storage of water in Sherburne and St. Mary Lakes, in Glacier Park, and its diversion through a canal about 29 miles long heading about 1 mile below the lower St. Mary Lake and discharging into the North Fork of the Milk River; thence flowing through Canada for 216 miles and returning to the United States for the irrigation of lands on the Milk River from above Chinook to and below Glasgow; the storage of water in Nelson Reservoir, located about 15 miles northeast of Malta; a storage reservoir on Beaver Creek about 20 miles southeast of Malta; a storage reservoir known as the Chain Lakes Reservoir, between Havre and the Canadian boundary; the diversion of water from the Milk River by three or more dams near Chinook and Harlem into canals on each side of the river, comprising the Chinook division; the diversion of water from the Milk River by a dam near Dodson into two canals, the north side canal irrigating lands near Dodson and Malta and the south canal conveying water to Nelson Reservoir and irrigating lands near Wagner, Malta, Bowdoin, Saco, and Hinsdale, comprising the Malta Division; and the diversion of water from the Milk River by a dam near Vandalia into a canal on the south side of the river for irrigation of lands near Tampico, Glasgow, and Nashua, comprising the Glasgow Division. No power and pumping works are under construction.

The average elevation of the irrigable area of the project is about 2,200 feet above sea level. The average rainfall is about 13 inches. The summer tem-



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perature ranges from about 100° F. downward and is conducive to the growth and maturing of crops. The character of the soil of the irrigable area is variable, being in some cases sandy loam, in other cases clay loam, and sometimes heavy gumbo or adobe. The principal products are alfalfa and other forage crops, grain, and vegetables, but alfalfa is becoming the leading crop, and alfalfa seed is extensively raised in the vicinity of Harlem. The crop return in 1919 averaged \$24.33 per acre. The principal markets are Minneapolis and St. Paul, Minn., and local points. The principal towns in the irrigable area are Chinook, Harlem, Dodson, Malta, Saco, Hinsdale, Glasgow, and Nashua. The main line of the Great Northern Railroad traverses the irrigable area for a distance of 150 miles.

The Sherburne Reservoir Dam has been nearly completed. The St. Mary Canal, which ultimately will have a capacity of 850 cubic feet per second, has been built to full size for the greater part of its length, although some of the larger structures, which ultimately will consist of twin conduits, have only one conduit installed, limiting the present capacity of the canal to one-half its ultimate capacity. The canal will now deliver into Milk River 425 cubic feet per second, and did deliver this quantity during 1918 and 1919 when such quantity was available for diversion from the St. Mary River. The Nelson Reservoir has been built to part capacity, and will now store 25,000 acre-feet. The diversion dams near Dodson and Vandalla have been built and canals have been constructed for the irrigation of 60,000 acres of land between Dodson and Glasgow. Water is being delivered on a rental basis to these lands, and also to the lands under private canals in the vicinity of Chinook and Harlem.

MONTANA, SUN RIVER PROJECT.

This project, located in Teton, Cascade, Lewis and Clark, and Chouteau Counties, contemplates the irrigation of about 174,600 acres of land, partly in Sun River Valley, but largely on the benches north of Sun River. The Fort Shaw division, located in the valley from 20 to 35 miles west of Great Falls, a thriving city of 35,000 people, has been in operation since 1908. It comprises about 15,000 acres of irrigable land, nearly all of which is entered. The water-right charge is \$36 per acre.

A portion of the lands in the Greenfields division, which is located on the north side of the river, received water in 1919 for the first time. The main canal from Sun River Diversion Dam, which is located near the edge of the Lewis and Clark Forest Reserve, extends easterly for a distance of about 46 miles to the first unit of 25,000 acres which begins at the town of Fairfield and extends toward Power a distance of 15 miles. About 3,000 acres of the first unit is vacant land which will probably be opened to entry in the fall of 1921, the building charge for which has not yet been announced.

Partial development of storage has been provided in a reservoir of 16,700 acre-feet capacity on Willow Creek, and further storage on the North Fork of Sun River is contemplated as soon as funds are available.

The soils are sandy loam, clay, adobe, and alluvium. There is no sage brush to be cleared, and the unimproved lands are covered with a growth of native pasture grasses. The principal crops are alfalfa, grain, and vegetables. The alfalfa acreage is increasing each year. The crop return in 1919 averaged \$42 per acre on the Fort Shaw Division. Dairy products are disposed of locally or by shipment to Great Falls. There has been rapid recent development of dairying, beekeeping, and growing of alfalfa and sweet clover for seed.

The elevation of the irrigable lands is from 3,500 to 4,000 feet above sea level, and the temperature ranges from 40° below to 100° above zero. The average rainfall is about 11 inches.

The project is served by three lines of railroad, all converging in Great Falls. The Gilman branch of the Great Northern passes through the entire length of the Fort Shaw division. On it are located the Government town sites of Fort Shaw and Simms, lots in which may be purchased at the local land office at Great Falls. The Great Northern also has another branch line skirting the Greenfields division on the east and north. At Power is available the Kansas City-Seattle service of the Burlington system, operating over Great Northern tracks. The Chicago, Milwaukee & St. Paul Railway has a branch extending from Great Falls through the western end of the Greenfields division. On this branch is located Fairfield, a thriving town 4 years old, which is the center of activities in this division. Banks are located on the project at Simms, Gilman, Fairfield, and Power, and near by are the several large banks of Great Falls and Choteau.



FARM SCENE ON LOWER YELLOWSTONE PROJECT, MONT.-N. DAK.

MONTANA-NORTH DAKOTA, LOWER YELLOWSTONE PROJECT.

The lands under this project are located in Dawson and Richland Counties, Mont., and McKenzie County, N. Dak. The total irrigable area, which consists of 59,529 irrigable acres, occupies the lower valley of the Yellowstone River and a portion of the Missouri River near the mouth of the Yellowstone River. Works have already been constructed to irrigate over 42,000 acres of land.

perature ranges from about 100° F. downward and is conducive to the growth and maturing of crops. The character of the soil of the irrigable area is variable, being in some cases sandy loam, in other cases clay loam, and sometimes heavy gumbo or adobe. The principal products are alfalfa and other forage crops, grain, and vegetables, but alfalfa is becoming the leading crop, and alfalfa seed is extensively raised in the vicinity of Harlem. The crop return in 1919 averaged \$24.93 per acre. The principal markets are Minneapolis and St. Paul, Minn., and local points. The principal towns in the irrigable area are Chinook, Harlem, Dodson, Malta, Saco, Hinsdale, Glasgow, and Nashua. The main line of the Great Northern Railroad traverses the irrigable area for a distance of 150 miles.

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A portion of the lands in the Greenfields division, which is located on the north side of the river, received water in 1919 for the first time. The main canal from Sun River Diversion Dam, which is located near the edge of the Lewis and Clark Forest Reserve, extends easterly for a distance of about 46 miles to the first unit of 25,000 acres which begins at the town of Fairfield and extends toward Power a distance of 15 miles. About 3,000 acres of the first unit is vacant land which will probably be opened to entry in the fall of 1921, the building charge for which has not yet been announced.

Partial development of storage has been provided in a reservoir of 16,700 acre-feet capacity on Willow Creek, and further storage on the North Fork of Sun River is contemplated as soon as funds are available.

The soils are sandy loam, clay, adobe, and alluvium. There is no sage brush to be cleared, and the unimproved lands are covered with a growth of native pasture grasses. The principal crops are alfalfa, grain, and vegetables. The alfalfa acreage is increasing each year. The crop return in 1919 averaged \$42 per acre on the Fort Shaw Division. Dairy products are disposed of locally or by shipment to Great Falls. There has been rapid recent development of dairying, beekeeping, and growing of alfalfa and sweet clover for seed.

The elevation of the irrigable lands is from 3,500 to 4,000 feet above sea level, and the temperature ranges from 40° below to 100° above zero. The average rainfall is about 11 inches.

The project is served by three lines of railroad, all converging in Great Falls. The Gilman branch of the Great Northern passes through the entire length of the Fort Shaw division. On it are located the Government town sites of Fort Shaw and Simms, lots in which may be purchased at the local land office at Great Falls. The Great Northern also has another branch line skirting the Greenfields division on the east and north. At Power is available the Kansas City-Seattle service of the Burlington system, operating over Great Northern tracks. The Chicago, Milwaukee & St. Paul Railway has a branch extending from Great Falls through the western end of the Greenfields division. On this branch is located Fairfield, a thriving town 4 years old, which is the center of activities in this division. Banks are located on the project at Simms, Gilman, Fairfield, and Power, and near by are the several large banks of Great Falls and Choteau.



FARM SCENE ON LOWER YELLOWSTONE PROJECT, MONT.-N. DAK.

MONTANA-NORTH DAKOTA, LOWER YELLOWSTONE PROJECT.

The lands under this project are located in Dawson and Richland Counties, Mont., and McKenzie County, N. Dak. The total irrigable area, which consists of 59,529 irrigable acres, occupies the lower valley of the Yellowstone River and a portion of the Missouri River near the mouth of the Yellowstone River. Works have already been constructed to irrigate over 42,000 acres of land.

The general elevation is 1,900 feet above sea level and the temperature ranges from 46° below to 110° above zero, although these extremes in temperature are very rare. The average rainfall is 15 inches per annum. The soil is a deep sandy loam with occasional small patches of gumbo, and the entire valley is considered very fertile and easily cultivated. For many years it was considered that only small grains could be profitably raised in this locality. However, the last few years have demonstrated that stock raising is very profitable and during 1919 nearly 400 acres of sugar beets were cropped. The acreage in alfalfa has gradually increased since the opening of the project in 1909 and there are now about 10,000 acres in this crop. Garden crops and all root crops are profitable. The crop return in 1919 averaged \$40.82 per acre.

The Great Northern and Northern Pacific railroads have branch lines in the valley, which roads meet at Sidney. The railroad towns are Intake, Burns, Savage, Crane, Sidney, Fairview, Dore, and Nohle. During the construction of the railroads, the growth of the towns was very rapid, but during the past four years the upbuilding of the farming community has been faster than that of the towns.

During the past six years water has been delivered on a rental basis.

NEBRASKA-WYOMING, NORTH PLATTE PROJECT.

This project as completed and in active construction is composed of the Interstate, Fort Laramie, and Northport units. The water supply is diverted from the North Platte River to these lands by means of two canals heading at Whalen, Wyo., and extending in a general southeasterly direction paralleling the valley and river course to within the vicinity of Bridgeport, Nebr., on the north side and to within the vicinity of Gering, Nebr., on the south side of the river. The latter canal may later be extended to cover additional lands. This canal is in course of construction and covers the Fort Laramie unit. The north side, or Interstate Canal, covers the Interstate unit. A third unit of the project is the Northport unit, which will be watered from an extension of a large private canal, the Tri-State Canal, on the north side of the river in the vicinity of Northport, Nebr. Construction has now been started on this unit. The aggregate irrigable area of these units is about 251,600 acres, distributed as follows: Interstate, 129,000; Fort Laramie, 107,000; and Northport unit, 15,000 acres. The Fort Laramie unit may be ultimately extended to cover an additional 25,000 acres. The average elevation is 4,100 feet above sea level and the temperature ranges from 30° below to 104° above zero. The average rainfall is 12 inches.

Storage water is provided by the Pathfinder Reservoir, having a capacity of 1,070,000 acre-feet, formed by the construction of the Pathfinder Dam across the North Platte River about 50 miles southwest of Casper, Wyo. This dam, which is one of the important structures of the Reclamation Service, is a rubble masonry arch 218 feet high and 432 feet long on top.

The principal markets for crops and live stock are Omaha, Kansas City, St. Joseph, Denver, and central Wyoming. The value of the crop return in 1919 on the Interstate unit averaged \$45.71.

Interstate unit.—The construction work on this unit has been completed and the unit has developed into a prosperous farming country. The soil is a fertile, sandy loam, which is especially adapted to the growing of alfalfa, cereals, and root crops. The principal crops are alfalfa, grains, sugar beets, and potatoes. About two-fifths of the cropped area in 1919 was in alfalfa. There are four beet-sugar factories on the project, one at Bayard, one at



DIGGING 70 ACRES POTATOES. NORTH PLATTE PROJECT. NEBR.

Gering, one at Mitchell, and one at Scottsbluff. This industry has developed very rapidly and is still growing. Winter feeding of cattle and sheep has grown to be a profitable industry, and the extent of this activity is steadily increasing. The hog-raising industry, which is steadily increasing, has also been profitable.

The principal towns on this unit are Bayard, Minatare, Scottsbluff, Mitchell, Morrill, and Henry, Nebr., and Torrington, Lingle, and Fort Laramie, Wyo. The Chicago, Burlington & Quincy Railroad traverses the entire length of this unit.

The construction charge for nearly all of the land on this unit is \$55. The lands are all in private ownership or have been entered under the terms of the reclamation act, but there are opportunities for purchasing lands in the various stages of development.

Fort Laramie unit.—The irrigation system on this unit will ultimately furnish water for the development of about 107,000 acres of land on the south side of the North Platte River, about one-half of which is in Wyoming and one-half in Nebraska. Construction work is now in progress on this unit. The soil varies from a fertile sandy loam to the heavier soils, being exceptionally good in some sections. The soil is especially adapted to growing of alfalfa, cereals, and the root crops.

The principal towns on the unit are Gering, Melbeta, McGrew, and Haig, Nebr. The Union Pacific Railroad has extended a branch from North Platte as far as Haig, Nebr., and surveys have been completed for the extension of this line to connect with the main line at some point in Wyoming. New towns will be started along this extension.

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The principal towns on the unit are Gering, Melbeta, McGrew, and Halg, Nebr. The Union Pacific Railroad has extended a branch from North Platte as far as Halg, Nebr., and surveys have been completed for the extension of this line to connect with the main line at some point in Wyoming. New towns will be started along this extension.

There are about 35,000 acres of vacant Government land on this unit which will be made available for entry under the terms of the reclamation act upon the completion of the construction work. Deeded land and assignments can occasionally be purchased.

Northport district.—The owners of about 15,000 acres of irrigable land in the vicinity of Northport and Bridgeport, Nebr., have organized an irrigation district under the laws of the State of Nebraska and have contracted with the United States Reclamation Service for the construction of the irrigation system. This district is located on the north side of the North Platte River, forming practically an extension of the Interstate unit; the land is of similar character to the lands of that unit, and the results obtained may be expected to be as satisfactory.

The Union Pacific Railroad crosses the district from east to west and the Denver-Alliance branch of the Chicago, Burlington & Quincy crosses it from north to south with an outlet to the west over the Alliance-Casper branch of this same system.

The land is practically all in private ownership, or has been entered under the homestead act. Deeded land or assignments can occasionally be purchased.

NEVADA, NEWLANDS PROJECT.

The Newlands project is located in Churchill and Lyon Counties in western Nevada, 300 miles east of San Francisco, Calif., on the Ogden route of the Southern Pacific Railway at an average elevation of about 4,000 feet above sea level. The temperature rarely goes below zero or above 100° F. The average



OATS IN SHOCK. NEWLANDS PROJECT, NEV

rainfall is 4 inches with practically no snow. The project, when complete, will embrace 231,000 acres of irrigable land. The soil varies from a heavy adobe clay to a light sandy loam. The heavy soil is best adapted to grain and sugar beets, and the lighter soils to alfalfa and fruit.

Alfalfa is the main crop on the project, and there are now about 25,000 acres of this crop. Grain, potatoes, sugar beets, and all kinds of vegetables do well on the project. Apples, pears, peaches, and small fruits are grown and are marketed locally and in the nearby mining towns. Potatoes, celery, and cantaloupes are shipped for special dining car and hotel consumption. Dairying is a growing and profitable industry. The crop return in 1919 averaged \$56.59 per acre, 43,296 acres being cropped. Several herds of pure blood Holsteins and Jerseys are now on the project, and all the grade herds are using pure blood sires. Good water for domestic use may be had anywhere on the project at depths varying from 16 to 75 feet. Artesian water may be had by boring to a depth of 200 feet. In some parts of the project hot water with a temperature of 185 degrees may be had at a depth of 250 feet.

The city of Fallon, situated in the center of the project has a population of 1,800. The city owns its own water and lighting systems. The county owns the telephone system, which reaches to every part of the project. The project is well supplied with churches and schools, the best high school in the State being situated at Fallon. The University of Nevada is located at Reno, just 60 miles from Fallon. The Lincoln Highway, on which a large amount of money is being spent, runs through the project from east to west for about 50 miles. The project towns are Fallon, Fernley, and Stillwater, all of which are situated in a good farming community.

A dam in the Truckee River at Derby, Nev., diverts the water from the Truckee River into a canal 31 miles long, which carries the water to Carson River at Lahontan. Here a storage dam and reservoir have been built for impounding the combined waters of Truckee and Carson Rivers for subsequent diversion into the head of the two main canals at a point about 5 miles downstream, where the Carson diversion dam is located. A hydroelectric power plant is located at Lahontan where the water from the Truckee River drops 125 feet into the Carson River. This plant is leased to the Canyon Power Co., which is distributing power to Fallon and neighborhood. The towns of Rochester and Lovelock are also furnished power, as are the mines surrounding them.

NEW MEXICO, CARLSBAD PROJECT.

The Carlsbad project embraces 25,000 acres of irrigable land in Eddy County, in the extreme southeastern part of the State. The project is traversed by the Santa Fe Railway, which connects at the south with the Texas & Pacific at Pecos, Tex. The irrigable land is about 3,100 feet above sea level, and the temperature ranges from about zero to 110° above. The average yearly precipitation is about 14 inches.

The soil is sandy loam of calcareous origin and is of good quality. The land is generally smooth and may be easily brought under cultivation. The native brush is mesquite. The two principal crops are alfalfa and cotton. The average yield of alfalfa is about 3 tons per season, with maximum yields of 6 tons. The average yield of cotton is about 0.6 bale per acre, with maximum yield of from 1 to 2½ bales per acre. The cotton industry has been very profitable, especially during the seasons of 1916-1919. The acreage in cotton in 1919 was about 8,700 acres. There are four cotton gins on the project.

The average gross value of all crops for the season of 1919 was \$106 per acre of cropped area, or a total value of \$1,988,546. The average value of the

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HOG RANCH. CARLSBAD PROJECT, N. MEX.

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Peaches, pears, apples, grapes, sweet potatoes, celery, onions, and garden truck may all be grown. Indian corn, small grains, and the sorghum-head corns are paying crops. The project is in the center of a large grazing country, and winter feeding on the farms is increasing each year. Many of the cattle and sheep men have purchased farms under the project, and the breeding of registered cattle and sheep on the farms is also increasing.

NEW MEXICO-TEXAS, RIO GRANDE PROJECT.

This project contemplates the reclamation of approximately 155,000 acres of land in New Mexico and Texas and 25,000 acres in the Republic of Mexico. The general elevation of the land is 3,700 feet above sea level, and the temperature ranges from -5° to 105° F. The average yearly rainfall is about 10 inches: The soil is rich alluvium and sandy loam and produces crops of alfalfa, corn, wheat, melons, fruit, and vegetables when irrigated.

Excellent railroad facilities are provided by the Atchison, Topeka & Santa Fe Railway, El Paso & Southwestern, Southern Pacific, and Texas & Pacific Railroads. A large mileage of paved roads has been constructed and hauling costs of products to near-by shipping points are small.

The Elephant Butte Dam, completed in 1913, across the Rio Grande near Elgie, N. Mex., is one of the largest structures of the Reclamation Service. This dam contains over a half million cubic yards of masonry, is 1,400 feet long on top, and will create the largest artificial lake for irrigation in the world.

In addition to the storage reservoir provided to assure a sufficient water supply, diversion dams have been constructed at different points in the project to divert irrigation water into canal systems.

To provide adequate drainage and protect project lands against seepage, the construction of 315 miles of drains is contemplated. The work already accomplished is providing drainage and protection for over 60,000 acres, and is approximately 50 per cent complete. Practically all project lands are in private ownership. Good farm lands can be bought at reasonable prices. El Paso, the principal center, has a population of approximately 78,000, and is a thriving and substantially built city. Las Cruces, N. Mex., and Clint, Tex., are outlying towns in the center of agricultural lands, connected by good roads and railways.



BEARDED WHEAT READY FOR HARVEST. MESILLA VALLEY, RIO GRANDE PROJECT. N. MEX.-TEX.

During the irrigation season of 1919 the total value of crop yield for the project, not including lands in Mexico, was \$3,825,107, or an average value per acre of crops of \$53.00.

Farm bureaus are established, one for New Mexico lands and one for Texas. Both are active and helpful organizations. The chamber of commerce of El Paso also maintains an agricultural department and cooperates with the Reclamation Service in settlement and technical work.

NORTH DAKOTA PUMPING PROJECT.

In western North Dakota the Reclamation Service is pumping water from the Missouri River and delivering it to lands which can not be reached by feasible gravity systems.



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The Williston unit covers about 11,000 acres of bench and valley lands surrounding Williston.

The general elevation of the lands is 1,900 feet above sea level, and the temperature ranges from 49° below to 107° above zero. The soil of the bottom lands is a heavy gumbo, and the bench lands are a rich sandy loam. The principal crops are wheat, flax, oats, barley, alfalfa, and potatoes. Sugar beets are likely to become an important crop. The acreage in alfalfa is increasing each year, and also the acreage in corn and potatoes.

Practically all the land is in private ownership, but the large farms are being subdivided and land can be bought at reasonable prices. The farm unit is 40 to 80 acres of irrigable land, but wherever practicable the farms contain a tract of grazing land which brings the area up to 160 acres. The Reclamation Service has contracted to furnish electrical energy to the municipality of Williston for a period of years.

The main line of the Great Northern Railroad passes through Williston, which is the marketing, shipping, and distributing point not only for the project, but for a large area north and south of it. A daily rural mail delivery is maintained over the project. The building charge is \$38 per acre.

The engineering features are unique. On account of the low fall of the Missouri River, gravity canals were not feasible and pumping was resorted to with power generated with lignite coal, deposits of which are found in this vicinity on Government land. The power plant is located near one of the coal outcrops, the fuel being mined and delivered by gravity to the boilers. Electrical energy is developed and transmitted to the various pumping stations, some of which are 28 miles distant. On account of the unstable character of the river banks the pumps are mounted on floating barges and connected to the shore by flexible pipes. The water is pumped into settling basins, from which gravity canals conduct and distribute it to the lands.

The 1917 legislature passed an irrigation district law under which the Williston project was organized into an irrigation district. A contract has been made with the district providing for a resumption of irrigation operations in 1919. The project was successfully operated in 1919 under the irrigation district plan. No construction payments will be required until 1924, when they will be resumed in accordance with the provisions of the reclamation extension act.

OREGON, UMATILLA PROJECT.

The Umatilla project is located about 190 miles east of Portland, in Umatilla County, and contains about 36,000 acres of land bordering on the Columbia River immediately east of Umatilla River. Water is now available for 24,625 acres, which have practically all been filed upon. There are some railroad and patented lands which may be purchased.

The land to be irrigated all lies below an elevation of 600 feet above sea level. Climatic conditions are favorable for the early ripening and marketing of small fruits, for which the soil is suited, as well as for deciduous fruits. Alfalfa is also grown. The value of the crop return in 1919 averaged \$74.83 per acre. Hog and poultry raising pay well, and bee colonies are profitable. Not only are the climate and soil such as to permit raising high-price crops, but the transportation facilities are excellent. In addition to the Oregon-Washington Railroad and Navigation Co.'s line which skirts the western end of the project, and the Spokane branch running through the northern portion, there is available the Columbia River which, since the Celilo Locks were completed, affords open navigation to Portland and Astoria.

The watershed area is 2,160 square miles, the average rainfall about 9 inches per annum, and the average annual run-off 525,000 acre-feet. The temperature ranges from 37° below to 115° above zero. The soil is sandy loam and volcanic ash. The project towns are Hermiston, Umatilla, Irrigon, and Boardman.

The engineering works include the diversion of water from the Umatilla River above Echo, Oreg., through a feed canal 24.5 miles long, into a storage reservoir with a capacity of 50,000 acre-feet. A by-pass canal has also been constructed so that water may be turned through it from the inlet canal directly into the distributing system without passing through the reservoir. The main canal for the west extension diverts water from the Umatilla River about halfway between Hermiston and Umatilla for the irrigation of about 10,000 acres.



CATTLE GRAZING IN ONE OF NATIONAL MEADOWS OF CRATER NATIONAL FOREST. KLAMATH PROJECT, OREG.

OREGON-CALIFORNIA, KLAMATH PROJECT.

This project involves the irrigation of about 141,000 acres of land lying in Klamath County, Oreg., and Modoc and Siskiyou Counties, Calif. The general elevation of the irrigable area is 4,100 feet above sea level, and the temperature ranges from 16° below to 100° above zero. The soil is exceedingly fertile, being composed of disintegrated basalt, volcanic ash, and diatomaceous earth, being largely classified as Yakima sandy loam.

The principal crops grown are alfalfa, wheat, oats, barley, rye, vegetables, and some deciduous fruits. The crop return in 1919 averaged \$26.30 per acre. The climate is especially adapted to dairying and stock raising. The markets are local towns, Portland, Oreg., and Sacramento and San Francisco, Calif.

The Williston unit covers about 11,000 acres of bench and valley lands surrounding Williston.

The general elevation of the lands is 1,900 feet above sea level, and the temperature ranges from 49° below to 107° above zero. The soil of the bottom lands is a heavy gumbo, and the bench lands are a rich sandy loam. The principal crops are wheat, flax, oats, barley, alfalfa, and potatoes. Sugar beets are likely to become an important crop. The acreage in alfalfa is increasing each year, and also the acreage in corn and potatoes.

Practically all the land is in private ownership, but the large farms are being subdivided and land can be bought at reasonable prices. The farm unit is 40 to 80 acres of irrigable land, but wherever practicable the farms contain a tract of grazing land which brings the area up to 160 acres. The Reclamation Service has contracted to furnish electrical energy to the municipality of Williston for a period of years.

The main line of the Great Northern Railroad passes through Williston, which is the marketing, shipping, and distributing point not only for the project, but for a large area north and south of it. A daily rural mail delivery is maintained over the project. The building charge is \$38 per acre.

The engineering features are unique. On account of the low fall of the Missouri River, gravity canals were not feasible and pumping was resorted to with power generated with lignite coal, deposits of which are found in this vicinity on Government land. The power plant is located near one of the coal outcrops, the fuel being mined and delivered by gravity to the boilers. Electrical energy is developed and transmitted to the various pumping stations, some of which are 28 miles distant. On account of the unstable character of the river banks the pumps are mounted on floating barges and connected to the shore by flexible pipes. The water is pumped into settling basins, from which gravity canals conduct and distribute it to the lands.

The 1917 legislature passed an irrigation district law under which the Williston project was organized into an irrigation district. A contract has been made with the district providing for a resumption of irrigation operations in 1919. The project was successfully operated in 1919 under the irrigation district plan. No construction payments will be required until 1924, when they will be resumed in accordance with the provisions of the reclamation extension act.

OREGON, UMATILLA PROJECT.

The Umatilla project is located about 190 miles east of Portland, in Umatilla County, and contains about 36,000 acres of land bordering on the Columbia River immediately east of Umatilla River. Water is now available for 24,625 acres, which have practically all been filed upon. There are some railroad and patented lands which may be purchased.

The land to be irrigated all lies below an elevation of 600 feet above sea level. Climatic conditions are favorable for the early ripening and marketing of small fruits, for which the soil is suited, as well as for deciduous fruits. Alfalfa is also grown. The value of the crop return in 1919 averaged \$74.83 per acre. Hog and poultry raising pay well, and bee colonies are profitable. Not only are the climate and soil such as to permit raising high-price crops, but the transportation facilities are excellent. In addition to the Oregon-Washington Railroad and Navigation Co.'s line which skirts the western end of the project, and the Spokane branch running through the northern portion, there is available the Columbia River which, since the Celilo Locks were completed, affords open navigation to Portland and Astoria.

The watershed area is 2,160 square miles, the average rainfall about 9 inches per annum, and the average annual run-off 525,000 acre-feet. The temperature ranges from 37° below to 115° above zero. The soil is sandy loam and volcanic ash. The project towns are Hermiston, Umatilla, Irigton, and Boardman.

The engineering works include the diversion of water from the Umatilla River above Echo, Oreg., through a feed canal 24.5 miles long, into a storage reservoir with a capacity of 50,000 acre-feet. A by-pass canal has also been constructed so that water may be turned through it from the inlet canal directly into the distributing system without passing through the reservoir. The main canal for the west extension diverts water from the Umatilla River about halfway between Hermiston and Umatilla for the irrigation of about 10,000 acres.



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The principal town on the project is Klamath Falls, located on Link River, and having about 5,000 inhabitants. Other towns in the valley are Merrill, Bonanza, Midland, and Malin. The California Northeastern Railway, a branch of the Southern Pacific road, and the Oregon-California & Eastern Railroad extend through the project. The reclamation plans involve, in addition to the irrigation of the valley lands, the reclamation by drainage and future irrigation of a portion of Tule Lake land which is now either swamp or lake bottom, and the irrigation of the foothill lands by pumping. Practically all the uplands, which include the greater part of the project, are held in private ownership, much being in large tracts which under the terms of the reclamation act must be subdivided in tracts of not to exceed 160 acres. The public lands under the project, which include a large portion of the lake areas, are at present withdrawn from entry. The water-right charge for the lands now open is \$30, \$39, and \$45 per acre.



FIELD OF CABBAGES ON BELLE FOURCHE PROJECT, S. DAK.

SOUTH DAKOTA, BELLE FOURCHE PROJECT.

The Belle Fourche project lies from 15 to 30 miles northeast of the Black Hills and extends from the diversion dam, 2 miles below the town of Belle Fourche, down the river a distance of approximately 35 miles. Eventually the project may cover about 98,000 acres of land. Works have been completed and the Reclamation Service is prepared to deliver water to 82,634 acres. Water-right applications had been filed covering about 76,000 acres of land on June 30, 1920.

The soil on that portion of the project lying to the north of the Belle Fourche River, and comprising about three-fourths of the project, is of a heavy clay

texture, known locally as gumbo. The soil texture of the area to the south of the river is of sandy loam. Well water may be found at reasonable depths in this district, but not so on the north side.

The season is from about April 15 to October 1, although killing frosts occasionally occur two weeks later in the spring and as much earlier in the fall. The temperature ranges from 30° below zero to 107° above. The precipitation average for 10 years is about 14 inches, the greater portion of which falls during the spring months.

The Belle Fourche Dam, one of the largest earthen structures of its kind, is 6,200 feet long, 115 feet high, and holds in storage at full capacity 203,000 acre-feet of water. The main north canal is about 45 miles long and the south canal about 40.

The principal towns on the project are Newell, Nisland, Fruitdale, Belle Fourche, and Vale. Deadwood and Lead are good towns in the Black Hills, some 40 miles from Newell, the reclamation headquarters and the only Government towns. It is also the terminus of the Chicago & North Western Railway. Belle Fourche is the largest town tributary to the project and is an important shipping point for live stock.

No public lands are available for entry. Good unimproved land can be purchased at from \$75 to \$100 per acre, and improved lands at from \$100 to \$150 per acre.

The principal crops grown are alfalfa, wheat, oats, barley, corn, flax, sugar beets, potatoes, and garden truck. All do well except corn, which makes a good crop about one year in three. The crop return in 1919 averaged \$34.89 per acre.

The climate and general conditions on the project are suitable for stock raising and dairying, and the latter industry is increasing from year to year.

UTAH, STRAWBERRY VALLEY PROJECT.

This project provides for the irrigation of about 60,000 acres of land in Utah County, lying along the east and south shores of Utah Lake, in the vicinity of the towns of Springville, Spanish Fork, and Payson. The Denver & Rio Grande, and the Los Angeles & Salt Lake Railroads pass through the middle of the project, and the Salt Lake and Utah Railway, an electric Interurban line from Salt Lake City, passes through Provo, the county seat, as well as all the principal towns on the project, terminating at Payson.

The lands have an elevation of from 4,300 to 4,600 feet, and the temperature ranges from 10° below to 95° above zero. The soil is sandy loam with gravel, and deep black soil in the bottom lands, and is exceedingly fertile, much of it being adapted for truck gardening. The rainfall averages 14.5 inches per annum, and the irrigation season is from April 15 to September 30. Alfalfa, hay, cereals, sugar beets, and vegetables are grown, and a ready market for everything raised is found in Salt Lake, which is 60 miles away, with good transportation facilities, and the nearby mining camps, many of which are within a 30-mile radius of the project. The crop return in 1919 averaged \$67.50 per acre.

An ample water supply is available from the Strawberry and Spanish Fork Rivers, the supply from the Strawberry River being stored in a reservoir with a capacity of 250,000 acre-feet and brought through the rim of the Great Basin by means of a tunnel 4 miles long.

Construction work on the project is well along, and during the irrigation season of 1919 water was supplied to approximately 2,000 landowners. Practically all the Government land supplied with water on the project has been taken up, but privately owned land can be purchased at a reasonable price.

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THINNING SUGAR BEETS NEAR PAYSON, STRAWBERRY VALLEY PROJECT, UTAH.

Sugar factories have been built near the towns of Payson, Spanish Fork, and Springville, and \$12 per ton is being paid for sugar beets delivered at beet dumps which the sugar companies have made an effort to locate at convenient points within the areas producing this crop.

A new power plant with equipment to develop 1,000 kilowatts was built to supply power for construction purposes, and in addition is supplying power to four towns on the project at a reasonable rate. This has greatly promoted general development both in the towns and rural communities.

All the water is sold and measured on the acre-foot basis, and the schedules of delivery are so arranged that the irrigator can get water at the time the crops require it.

The Midland and Arrow Head trails pass through the project and are well maintained by the State and county.

WASHINGTON, OKANOGAN PROJECT.

The Okanogan project comprises about 10,000 acres of land in Okanogan County. The soil is volcanic ash, sand, and gravel, and is for the most part first-class apple land. Grain, hay, corn, and vegetables are grown, but the main crop is apples. Practically all the products except fruit are raised between the tree rows of young orchards. Raw land sells for \$200 to \$250 per acre and improved lands for \$750 to \$1,500 per acre.

The average elevation of the irrigable lands is 1,000 feet above sea level, and the temperature ranges from 10° below to 105° above zero. On account of the

possibilities of high development, the size of the farm unit has been limited to 40 acres, and the average size of the farm is less than 20 acres. The building charge is \$95 per acre. This charge will be increased to provide for additional storage and for other improvements to the present system. The lands have all been filed upon and can be acquired now only by purchase from present owners. The gross return for the 5,314 acres cropped during the 1919 season amounted to \$367.23 per acre.

The Great Northern Railroad has a branch line with daily train service through the project. The project towns are Okanogan, Omak, and Riverside.

WASHINGTON, YAKIMA PROJECT.

On the eastern slope of the Cascade Mountains in Washington is a succession of valleys in the drainage basin of Yakima River. It is estimated that with storage the water supply is sufficient for about 576,500 acres of land. The present development consists of storage in several mountain lakes and the construction of irrigation systems for the Sunnyside and Tieton units.

Sunnyside unit.—This unit comprises about 111,000 acres of land lying in Yakima and Benton Counties. The irrigation system originally constructed by a private organization was purchased by the Government and has been extended and enlarged. The average elevation of the lands is 800 feet above sea level, and the temperature ranges from 21° below to 110° above zero. It is very rarely, however, that either of these extremes is reached. The soil is mostly deep volcanic ash, merging in certain localities into sandy loam or decomposed basalt, easily tilled, and responding readily to irrigation. The principal products are forage, fruits, and vegetables, dairy and poultry products. The markets are Washington cities, Alaska, and in the case of fruits the entire country and foreign market. The main portion of this unit is traversed by the Northern Pacific and the Oregon-Washington Railroad and Navigation Co.'s lines. The towns within the boundaries of this unit, situated along the two lines of railroad, are Grandview, Sunnyside, Outlook, Granger, Zillah, Mabton, Byron, and Prosser. The cost of water right is from \$52 to \$125 per acre. In 1919, 75,886 acres were cropped, the total value amounting to \$12,678,247, an average value of \$167.07 per acre. There is no land available for homestead entry at the present time, but excellent raw land may be had at \$50 to \$100 per acre, water right unpaid, and some rougher lands with paid-up water rights may be had at from \$60 to \$100 per acre. Improved land adapted to general farming brings from \$150 to \$400 per acre, and choice bearing orchards may be had at \$500 to \$1,500 per acre.

Tieton unit.—The unit covers 32,000 acres of irrigable land in Yakima County near the city of Yakima. The elevation is from 1,300 to 2,100 feet above sea level, and the temperature ranges from 21° below to 110° above zero. The soil is volcanic ash, exceedingly fertile and particularly adapted to fruit growing. Approximately 8,000 acres were planted to fruit trees, principally winter apples, during the first years of development, and these trees are now in bearing and produce very satisfactory returns. Of recent years, however, the tendency has been toward more diversified farming with dairy stock, sheep, and hogs to consume on the farm a large proportion of the crops. Potatoes, onions, beans, and other truck crops are also profitable. The total crop value in 1919 from 26,300 acres was \$4,053,168, an average production per acre of \$154.10. The lands are tributary to the Northern Pacific and the Oregon-Washington Railroad and Navigation Co.'s lines. The Yakima Valley Transportation Co.'s trolley line extends over a portion of this unit. The markets are Seattle, Tacoma, Spokane,



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Alaska, and eastern cities. The towns on this unit are Yakima, Naches, Cowiche, and Tieton, with a number of other shipping points on branches of the railroads which now extend to the extreme limits of the project. The lands are all in private ownership. Some very good farms are offered for sale at prices ranging from \$50 to \$100 per acre for sagebrush land, and \$150 to \$400 per acre for improved farm lands. The average cost of water right is about \$105 per acre.

The business center of the entire Yakima project is at Yakima, a city of about 18,000 population, lying between the Sunnyside and Tieton units, and centrally located with reference to about 250,000 acres of land in the Yakima Valley now under irrigation and some 500,000 acres that will be ultimately irrigated.

Good automobile roads follow the Tieton, Naches, and Yakima Rivers to the very summit of the mountains, and a large proportion of the project farmers make it a point every season to spend a few days, at least, fishing, boating, or simply resting at the headwaters of the streams that are the source of supply of the irrigation systems.

WYOMING, RIVERTON PROJECT.

The Riverton project covers about 100,000 acres of land in Fremont County, Wyo., located north of Wind River and west of the Big Horn River, and about 125 miles west of Casper. The average altitude is about 5,200 feet. The temperature ranges from 30° below to 102° above zero. The average annual precipitation is about 8 inches.

The soil ranges from a sandy loam to a heavy clay. It is well suited for the raising of alfalfa, grains, sugar beets, potatoes, and vegetables. Excellent crops are produced on the neighboring lands, under private irrigation. It is not likely that any land on this project will be irrigated prior to 1923.

The building charge has not yet been announced. About 30 per cent of the land is in private ownership and the remainder is public land, which will ultimately be open for homestead entry. As the lands are a part of the ceded portion of the Wind River Indian Reservation, the settlers will be required to make a small payment per acre to the Indians in addition to the building charge.

The water supply is ample and relatively small storage will be required. The principal engineering features will be the Bull Lake and Pilot Butte Reservoirs, with available capacities of about 115,000 and 30,000 acre-feet, respectively. There will also be a concrete diversion dam and headworks on Wind River, at which will be diverted the Wyoming Canal, whose length will be about 30 miles.

The project is now served by the Chicago & Northwestern Railroad and the larger part of it is tributary to the town of Riverton. A smaller portion is tributary to the town of Shoshoni. As the project is developed other railroad facilities will undoubtedly become available and new towns will be built in the interior of the project. The markets are Riverton, Casper, and other central Wyoming points, Omaha and Denver.

WYOMING, SHOSHONE PROJECT.

The Shoshone project is located in northern Wyoming, about 75 miles east of Yellowstone National Park, and includes about 235,000 acres of irrigable lands, of which about 90,000 acres lie in the Oregon Basin division. The elevation of the irrigable area is about 4,500 feet above sea level, and the temperature



ONIONS GROWN ON SHOSHONE PROJECT, WYO.

ranges from 32° below to 103° above, but rarely reaches either extreme. The valley is well protected by mountain ranges on every side. The soil is light, sandy, and clay loam. Alfalfa, wheat, oats, barley, sugar beets, and potatoes are the principal crops. The largest acreage is alfalfa, but the old fields are being plowed up and planted to potatoes and sugar beets, which give excellent returns. Alfalfa has always found a ready market, and there are two alfalfa mills on the project where loose hay is purchased at the market price, which in past years has ranged from \$15 to \$20 per ton. Many of the farmers are engaging in dairying and stock raising. Hogs are also an important live-stock industry. Bees do well and the honey is an excellent quality. The farms range in size from 40 to 80 acres, most of them being of the latter acreage. The crop returns on the Garland division in 1919 averaged \$49.98 per acre. There are only a very few vacant units on the Garland division. The first unit of the Frannie division was opened in September, 1917, and the second unit in October, 1919, and March, 1920, and nearly all of these farms have been covered by homestead entry. The Hart Mountain division, containing 38,800 acres; the Willwood, containing 15,000 acres; and the third unit, Frannie division, containing 15,000, remain to be completed. This work will be carried on as fast as funds are made available by congressional appropriation. The Reclamation Service is also investigating the feasibility of the Oregon Basin division, which is located about 12 miles south of the Shoshone project. This division contains an area of about 90,000 acres, which can be irrigated from Shoshone Reservoir. The water supply is adequate for all of the lands in the Shoshone project, as the annual run-off is about 1,132,500 acre-feet. The markets for the farm products are Omaha, Kansas City, Chicago, Denver, and Bil-

Alaska, and eastern cities. The towns on this unit are Yakima, Naches, Cowiche, and Tieton, with a number of other shipping points on branches of the railroads which now extend to the extreme limits of the project. The lands are all in private ownership. Some very good farms are offered for sale at prices ranging from \$50 to \$100 per acre for sagebrush land, and \$150 to \$400 per acre for improved farm lands. The average cost of water right is about \$105 per acre.

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The water supply is ample and relatively small storage will be required. The principal engineering features will be the Bull Lake and Pilot Butte Reservoirs, with available capacities of about 115,000 and 30,000 acre-feet, respectively. There will also be a concrete diversion dam and headworks on Wind River, at which will be diverted the Wyoming Canal, whose length will be about 30 miles.

The project is now served by the Chicago & Northwestern Railroad and the larger part of it is tributary to the town of Riverton. A smaller portion is tributary to the town of Shoshoni. As the project is developed other railroad facilities will undoubtedly become available and new towns will be built in the interior of the project. The markets are Riverton, Casper, and other central Wyoming points, Omaha and Denver.

WYOMING, SHOSHONE PROJECT.

The Shoshone project is located in northern Wyoming, about 75 miles east of Yellowstone National Park, and includes about 235,000 acres of irrigable lands, of which about 90,000 acres lie in the Oregon Basin division. The elevation of the irrigable area is about 4,500 feet above sea level, and the temperature



ONIONS GROWN ON SHOSHONE PROJECT, WYO.

ranges from 32° below to 103° above, but rarely reaches either extreme. The valley is well protected by mountain ranges on every side. The soil is light, sandy, and clay loam. Alfalfa, wheat, oats, barley, sugar beets, and potatoes are the principal crops. The largest acreage is alfalfa, but the old fields are being plowed up and planted to potatoes and sugar beets, which give excellent returns. Alfalfa has always found a ready market, and there are two alfalfa mills on the project where loose hay is purchased at the market price, which in past years has ranged from \$15 to \$20 per ton. Many of the farmers are engaging in dairying and stock raising. Hogs are also an important live-stock industry. Bees do well and the honey is an excellent quality. The farms range in size from 40 to 80 acres, most of them being of the latter acreage. The crop returns on the Garland division in 1919 averaged \$49.98 per acre. There are only a very few vacant units on the Garland division. The first unit of the Franine division was opened in September, 1917, and the second unit in October, 1919, and March, 1920, and nearly all of these farms have been covered by homestead entry. The Hart Mountain division, containing 38,800 acres; the Willwood, containing 15,600 acres; and the third unit, Franine division, containing 15,000, remain to be completed. This work will be carried on as fast as funds are made available by congressional appropriation. The Reclamation Service is also investigating the feasibility of the Oregon Basin division, which is located about 12 miles south of the Shoshone project. This division contains an area of about 90,000 acres, which can be irrigated from Shoshone Reservoir. The water supply is adequate for all of the lands in the Shoshone project, as the annual run-off is about 1,132,500 acre-feet. The markets for the farm products are Omaha, Kansas City, Chicago, Denver, and Bil-

lings, Mont. The Chicago, Burlington & Quincy Railroad furnishes transportation. The project towns are Cody, Ralston, Powell, Garland, Frannie, and Deaver. Schools, churches, banks, newspapers, and manufacturing establishments have been installed, and the project has most of the modern conveniences of settled communities. An excellent city water system has been constructed in both Powell and Deaver. The beets now raised are shipped to Lovell, Wyo., which is located about 20 miles southeast of Powell. The Great Western Sugar Co. has purchased a site near Powell and will erect buildings as soon as the beet acreage warrants the construction of the factory. A potato-growers' association has been formed. The surrounding mountains furnish an excellent supply of timber, and stock may be ranged during the summer under the supervision of the Forest Service. Oil has been developed in fields lying to the north and also southeast of the Shoshone project, and natural gas has been found on the Frannie division. Good wells of domestic water are usually found at depths ranging from 30 to 100 feet.

The engineering work is unusually interesting, involving the construction of Shoshone Dam, which is 328 feet high, 108 feet thick on the bottom, and only 200 feet long on top. The reservoir created thereby has an area of 6,000 acres and a capacity of 456,000 acre-feet. Sixteen miles below a low concrete diversion dam across Shoshone River turns the water through a concrete-lined tunnel, 3½ miles long, into the canal system which irrigates the Garland and Frannie divisions. The canal system for the Hart Mountain division would divert direct at Shoshone Dam, and for the Willwood division the main canal would take out of Shoshone River about 8 miles below Corbett Diversion Dam.

INDIAN PROJECTS.

MONTANA, BLACKFEET PROJECT.

The Blackfeet project is located in the northwestern part of Montana just east of the main range of the Rocky Mountains, principally on the Blackfeet Indian Reservation. The irrigation of 118,500 acres is contemplated under the completed project, and 48,240 acres are covered by irrigation works now constructed. The general elevation is 3,800 feet above sea level. The temperature varies from 56° below to 100° above, and, although the winters are generally severe, the summers are long enough to raise good root, grain, and forage crops and are almost free from oppressive heat. The soil varies from gravelly loam to gumbo, but is principally sandy loam.

The land under the completed works is in four units. One of 24,000 acres along the Great Northern Railway in the eastern part of the reservation; one of 18,000 acres in the southeastern part of the reservation; and two small units, one on Badger Creek in the south central part of the reservation, and one on Birch Creek in the very southern part of the reservation. Nearly all of the land is allotted to Indians but competent Indians are now receiving patents to their land and a good many irrigable units are for sale at reasonable prices. The construction charge has not been announced, but water is being delivered on a rental basis.

Grain and forage are the principal crops that have been successfully raised. The reservation is probably one of the best stock-raising sections in the country and the prospect for successfully raising and feeding forage crops on the irrigable area is particularly promising. The value of the crop return in 1919 averaged \$33.37 per acre.

As the reservation lands have not been open to entry by whites there has been little development in the way of modern towns, schools, churches, etc.

MONTANA, FLATHEAD PROJECT.

The Flathead project is located on the former Flathead Indian Reservation and has an area of 134,500 acres.

The main project lies in the Mission Valley at the foot of Flathead Lake. Other smaller units lie in the Jocko Valley and the Little Bitter Root Valley.

About 60 per cent of the land under the project was allotted to Indians before the reservation was opened. The remainder of the land was entered as homesteads except for a small amount of State land. Land belonging to incompetent and deceased Indians is placed on sale, generally twice each year, at the Flathead Indian Agency, Dixon, Mont. No irrigable land remains subject to homestead entry.

The principal crops at the present time are grains and hay. Alfalfa and sugar beets are grown successfully but as yet not extensively. The land is ideal for the production of hay crops and, with the better marketing facilities afforded by the new Flathead branch of the Northern Pacific Railway, dairying is expected to become one of the leading industries of the project. The crop return in 1919 averaged \$30 per acre.

Canals have been completed for 98,000 acres of the project and storage to the extent of 57,000 acre-feet has been provided. Works for the completion of the project have been surveyed and are under construction.

The average elevation of the irrigable area is 3,000 feet above sea level. The irrigation season is from May 1 to September 30, 153 days. The average rainfall near the Mission Range is 17 inches, on parts of the project farther from the mountains it is less. The range of temperature is from -30° to 96°. The winters are generally mild with little wind. There are few severe storms or protracted cold spells.

The project has good roads, excellent school facilities and churches, and fine mountain scenery, lakes, and streams within easy driving distance from the irrigable lands.

MONTANA, FORT PECK PROJECT.

The Fort Peck project is located in the northwestern part of Montana on what was formerly the Fort Peck Indian Reservation. On this project 152,000 acres are irrigable, and the irrigation works have been completed to 16,620 acres. The general elevation is 2,000 feet above sea level and it has a delightful summer climate with rather severe winters. The temperature varies from 40° below to 100° above zero. The soil varies from sandy loam to gumbo.

The land under irrigation is located in small units along the Great Northern Railway. A major portion of the land is allotted to the Indians, many of whom have received patent in fee and the land can be purchased of them. The charge for water has not been announced by the Secretary of the Interior.

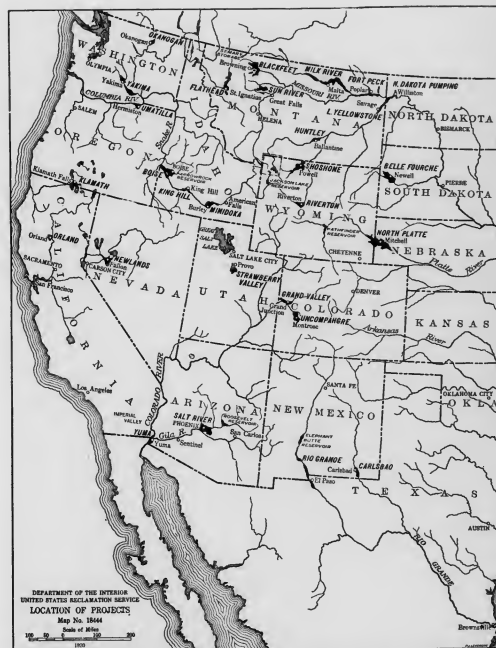
The principal crops are alfalfa, grains, and root crops. Owing to the great amount of grazing land adjoining the project there is always a demand for forage crops for winter feed. The value of the crop return in 1919 averaged \$23.85 per acre.

There are five good towns on the project, all provided with modern schools and churches and the country is just beginning to develop.

WHERE TO MAKE HOMESTEAD ENTRY.

Homestead entries for public lands on the various reclamation projects may be made at the land offices listed below. Additional information concerning the reclamation projects may be obtained by addressing the statistician, United States Reclamation Service, Washington, D. C., or the project managers at the offices of the projects as listed below:

State.	Project.	Project office.	Land office.
Arizona	Salt River	Phoenix	Phoenix.
Arizona	Yuma	Yuma	Phoenix.
California	Yuma	Yuma, Ariz.	Los Angeles.
California	Orland	Orland	Sacramento.
California	Klamath	Klamath Falls, Oreg.	Redding and Susanville.
Colorado	Grand Valley	Grand Junction	
Colorado	Uncompahgre	Montrose	Montrose.
Idaho	Minidoka	Burley	Hailey.
Idaho	Boise	Boise	Boise.
Montana	Huntley	Ballantine	Billings.
Montana	Lower Yellowstone	Savage	Miles City.
Montana	Milk River	Malta	Great Falls.
Montana	Sun River	Great Falls	Great Falls.
Nebraska	North Platte	Mitchell	Alliance.
Nevada	Newlands	Fallon	Carson City.
New Mexico	Carlsbad	Carlsbad	Roswell.
New Mexico	Rio Grande	El Paso, Tex.	Las Cruces.
North Dakota	Williston	Williston	Williston.
Oregon	Klamath	Klamath Falls	Lake View.
Oregon	Umatilla	Hermiston	La Grande.
South Dakota	Belle Fourche	Newell	Rapid City and Belle Fourche.
Utah	Strawberry Valley	Provo	Salt Lake City.
Washington	Okanogan	Okanogan	Waterville.
Washington	Sunnyside	Yakima	Yakima.
Washington	Tieton	Yakima	Yakima.
Wyoming	North Platte	Mitchell, Neb.	Cheyenne.
Wyoming	Shoshone	Powell	Lander.



PRINCIPAL IRRIGATION PROJECTS CONSTRUCTED AND UNDER CONSTRUCTION BY THE U. S. RECLAMATION SERVICE IN THE WESTERN UNITED STATES.

RECLAMATION ACT.

GENERAL ACTS.

An Act Appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all moneys received from the sale and disposal of public lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming, beginning with the fiscal year ending June thirtieth, nineteen hundred and one, including the surplus of fees and commissions in excess of allowances to registers and receivers, and excepting the five per centum of the proceeds of the sales of public lands in the above States set aside by law for educational and other purposes, shall be, and the same are hereby reserved, set aside, and appropriated as a special fund in the Treasury to be known as the "reclamation fund," to be used in the examination and survey for and the construction and maintenance of irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the said States and Territories, and for the payment of all other expenditures provided for in this act: *Provided,* That in the case the receipts from the sale and disposal of public lands other than those realized from the sale and disposal of lands referred to in this section are insufficient to meet the requirements for the support of agricultural colleges in the several States and Territories, under the act of August thirtieth, eighteen hundred and ninety, entitled "An act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts, established under the provisions of an act of Congress approved June second, eighteen hundred and sixty-two," the deficiency, if any, in the sum necessary for the support of the said colleges shall be provided for from any moneys in the Treasury not otherwise appropriated.

Sec. 2. That the Secretary of the Interior is hereby authorized and directed to make examinations and surveys for, and to locate and construct, as herein provided, irrigation works for the storage, diversion, and development of waters, including artesian wells, and to report to Congress at the beginning of each regular session as to the results of such examinations and surveys, giving estimates of cost of all contemplated works, the quantity and lands which can be irrigated therefrom, and the facts relative to the practicability of each irrigation project; also the cost of works in process of construction as well as of those which have been completed.

Sec. 3. That the Secretary of the Interior shall, before giving the public notice provided for in section four of this act, withdraw from public entry the lands required for any irrigation works contemplated under the provisions of this act, and shall restore to public entry any of the lands so withdrawn when, in his judgment, such lands are not required for the purposes of this act; and the Secretary of the Interior is hereby authorized, at or immediately prior to the time of beginning the surveys for any contemplated irrigation works, to withdraw from entry, except under the homestead laws, any public lands believed to be susceptible of irrigation from said works: *Provided,* That all lands entered and entries made under the homestead laws within areas so withdrawn during such withdrawal shall be subject to all the provisions, limitations, charges, terms, and conditions of this act; that said surveys shall be prosecuted diligently to completion, and upon the completion thereof, and of the necessary maps, plans and estimates of cost, the Secretary of the Interior shall determine whether or not said project is practicable and advisable, and if determined to be impracticable or inadvisable he shall thereupon restore said lands to entry; that public lands which it is proposed to irrigate by means of any contemplated works shall be subject to entry only under the provisions of the homestead laws in tracts of not less than forty nor more than one hundred and sixty acres, and shall be subject to the limitations, charges, terms, and conditions herein provided: *Provided,* That the commutation provisions of the homestead laws shall not apply to entries made under this act.

Sec. 4. That upon the determination by the Secretary of the Interior that any irrigation project is practicable, he may cause to be let contracts for the construction of the same, in such portions or sections as it may be practicable to construct and complete as parts of the whole project, providing the necessary funds for such portions or sections are available in the reclamation fund, and thereupon he shall give public notice of the lands irrigable under each project and limit of payment on each acre of land to be so irrigated, in which notice he shall state, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question; also of the charges which shall be made per acre under the said entries, and upon lands in private ownership which may be irrigated by the waters of the said irrigation project, and the number of annual installments, in which such charges shall be paid, and in which such lands shall not such payments shall commence. The said charges shall be determined with a view of returning to the reclamation fund the estimated cost of construction of the project, and shall be apportioned equitably: *Provided,* That all construction work eight hours shall constitute a day's work, and no Mongolian labor shall be employed thereon.

Sec. 5. That the entryman upon lands to be irrigated by such works, in addition to compliance with the homestead laws, reclaim at least one-half of the total irrigable area of his entry for agricultural purposes, and before receiving patent for the lands covered by his entry shall pay to the Government the sum of ten dollars per acre. The annual installments shall be paid to the receiver of the local land office of the district in which the land is situated, and failure to make such payments shall render the entry subject to cancellation, with the forfeiture of all rights under this act, as well as of any moneys already paid thereon. All moneys received from the above sources shall

¹ Sec. 5. Manner of payments, amended by act of Aug. 9, 1912.

be paid into the reclamation fund. Registers and receivers shall be allowed the usual commissions on all moneys paid for lands entered under this act.

Sec. 6. That the Secretary of the Interior is hereby authorized and directed to use the reclamation fund for the operation and maintenance of all reclamation works constructed under the provisions of this act: *Provided,* That when the payments required by this act are made for the major portion of the lands irrigated from the waters of any of the works herein provided for, then the management and operation of such irrigation works shall pass to the owners of the lands irrigated thereby, to be maintained at their expense under such form of contract as the Secretary of the Interior may determine, and under such rules and regulations as may be approved by the Secretary of the Interior: *Provided,* That the title to and the management and operation of the reservoirs and the works necessary for their protection and operation shall remain in the Government until otherwise provided by Congress.

Sec. 7. That where in carrying out the provisions of this act it becomes necessary to acquire any rights or property the Secretary of the Interior is hereby authorized to acquire the same for the United States by purchase or by condemnation under judicial process, and to pay from the reclamation fund the sum which may be needed for that purpose, and it shall be the duty of the Attorney General of the United States upon every application of the Secretary of the Interior, under this act, to cause proceedings to be commenced for condemnation within thirty days from the receipt of the application at the Department of Justice.

Sec. 8. That nothing in this act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the sub-irrigation, appropriation, use, or distribution of water used in irrigation or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal Government or of any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof: *Provided,* That the right to the use of water acquired under the provisions of this act shall be appurtenant to the land irrigated and beneficial use shall be the basis, the measure, and the limit of the right.

Sec. 9. That it is hereby declared to be the duty of the Secretary of the Interior in carrying out the provisions of this act to make the most judicious use of the same with respect to the existence of feasible irrigation projects, to expend the major portion of the funds arising from the sale of public lands within each State and Territory hereinafter named for the benefit of arid and semiarid lands within the limits of such State or Territory: *Provided,* That the Secretary may temporarily use such portion of said funds for the benefit of arid or semiarid lands outside the limits of such State or Territory hereinafter named as he may deem advisable, but when so used the excess shall be restored to the fund as soon as practicable, to the end that ultimately, and in any event, within each ten-year period after the passage of this act, the expenditures for the benefit of the said States and Territories shall be equalized according to the proportions and subject to the conditions as to practicability and feasibility aforesaid.

Sec. 10. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this act into full force and effect.

Approved, June 17, 1902 (32 Stat., 388).

[PUBLIC-NO. 10. 470-63D CONGRESS.]

[S. 628.]

An Act Extending the period of payment under reclamation projects, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That any person whose lands hereafter become subject to the terms and conditions of the act approved June seventeenth, nineteen hundred and two, entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," and any amendments thereof or supplementary thereto, shall be subject to the provisions of said act, and any person who hereafter makes entry thereunder shall at the time of making water-right application or entry, as the case may be, pay into the reclamation fund five per centum of the construction charge fixed for his land as an initial installment, and shall pay the balance of said charge in fifteen annual installments, the first five of which shall each be seven per centum until the whole amount shall have been paid. The first of the annual installments shall become due on the first of January of the fifth calendar year after the date of the entry: *Provided,* That any water-right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period: *Provided further,* That entry may be made whenever water is available, as announced by the Secretary of the Interior, and the initial payment be made when the charge per acre is established.

ACT SHALL APPLY TO EXISTING PROJECTS.

Sec. 2. That any person whose land or entry has heretofore become subject to the terms and conditions of the reclamation law, and who has not fully paid the balance of the portion of the construction charge remaining unpaid, in twenty annual installments, the first of which shall become due and payable on December first of the year in which the public notice affecting his land was issued under this act, and subsequent installments on December first of each year thereafter. The first four of such installments shall each be two per centum, the next two installments shall each be four per centum, and the next fourteen each six per centum of the total construction charge, or the portion of the construction charge unpaid at the beginning of such installments.

PENALTIES.

Sec. 3. That if any water-right applicant or entryman shall fail to pay any installment of his construction charge when due, there shall be added to the amount unpaid a penalty of one per centum thereof, and there shall be added a like penalty of one

² Sec. 9 repealed by act of June 25, 1910.

per centum of the amount unpaid on the first day of each month thereafter so long as such default shall continue. If any such applicant or entryman shall be one year in default in the payment of any installment of the construction charges and penalties, or any part thereof, his water-right application, and if he be a homestead entryman his entry also, shall be subject to cancellation, and all payments made by him forfeited to the reclamation fund, but no homestead entry shall be subject to contest because of such default; *Provided*, That if the Secretary of the Interior shall so elect, he may cause suit or action to be brought for the recovery of the amount in default and penalties; but if suit or action be brought, the right to declare a cancellation and forfeiture shall be suspended pending such suit or action.

INCREASE OF CHARGES.

SEC. 4. That no increase in the construction charges shall hereafter be made, after the same have been fixed by public notice, except by agreement between the Secretary of the Interior and a majority of the water-right applicants and entrymen to be affected by such increase, whereupon all water-right applicants and entrymen in the area proposed to be affected by the increased charge shall become subject thereto. Such increased charge shall be added to the construction charge and payment thereof distributed over the remaining unpaid installments of construction charges; *Provided*, That the Secretary of the Interior, in his discretion, may agree that such increased construction charge shall be paid in additional annual installments, each of which shall be at least equal to the amount of the largest installment as fixed for the project by the public notice theretofore issued. And such additional installments of the increased construction charge, as so agreed upon, shall become due and payable on December first of each year subsequent to the year when the final installment of the construction charge under such public notice is due and payable; *Provided further*, That all such increased construction charges shall be subject to the same conditions, penalties, and suit or action as provided in section three of this act.

OPERATION AND MAINTENANCE.

SEC. 5. That in addition to the construction charge, every water-right applicant, entryman or landowner under or upon a reclamation project shall also pay whenever water service is available for the irrigation of his land, an operation and maintenance charge based upon the total cost of operation and maintenance of the project, or such separate unit thereof, and such charge shall be made for each acre-foot of water delivered; but each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge based upon the charge for delivery or not of at least one acre-foot of water; *Provided*, That, whenever any legally organized water users' association or irrigation district shall so request, the Secretary of the Interior is hereby authorized, in his discretion, to transfer to such water users' association or irrigation district the care, operation, and maintenance of all or any part of the project works, subject to such rules and regulations as he may prescribe. If the total amount of operation and maintenance charges and penalties collected for any one irrigation season on any project shall exceed the cost of operation and maintenance of the project during that irrigation season, the balance shall be applied to a reduction of the charge on the project for the next irrigation season, and any deficit incurred likewise be added to the charge for the next irrigation season.

PENALTIES.

SEC. 6. That all operation and maintenance charges shall become due and payable on the date fixed for each project by the Secretary of the Interior, and if such charge is paid on or before the date when due there shall be a discount of five centum of such charge; but if such charge is unpaid on the first day of the third calendar month thereafter, a penalty of one per centum of the amount unpaid shall be added thereto, and thereafter an additional penalty of one per centum of the amount unpaid shall be added on the first day of each calendar month if such charge and penalties shall remain unpaid, and no water shall be delivered to the lands of any water-right applicant or entryman who shall be in arrears for more than one calendar year for the payment of any charge for operation and maintenance, or any annual construction charge and penalties. If any water-right applicant or entryman shall be one year in arrears in the payment of any charge for operation and maintenance and penalties, or any part thereof, his water-right application, and if he be a homestead entryman his entry also, shall be subject to cancellation, and all payments made by him forfeited to the reclamation fund, but no homestead entry shall be subject to contest because of such arrears. In the discretion of the Secretary of the Interior suit or action may be brought for the amount in default and penalties in like manner as provided in section three of this act.

FISCAL AGENT.

SEC. 7. That the Secretary of the Interior is hereby authorized, in his discretion, to designate and appoint under such rules and regulations as he may prescribe, the legally organized water users' association or irrigation district, under any reclamation project, as the fiscal agent of the United States to collect the annual payments on the construction charge of the project and the annual charge for operation and maintenance and all penalties; *Provided*, That no water-right applicant or entryman shall be entitled to credit for any payment thus made until the same shall have been paid over to an officer designated by the Secretary of the Interior to receive the same.

RECLAMATION REQUIREMENTS.

SEC. 8. That the Secretary of the Interior is hereby authorized to make general rules and regulations governing the use of water in the irrigation of the lands within any project, and may require the reclamation for agricultural purposes and the cultivation of one-fourth the irrigable area under each water-right application or entry within three full irrigation seasons after the filing of water-right application or entry, and the reclamation for agricultural purposes and the cultivation of one-half the irrigable area within five full irrigation seasons after the filing of the water-right application or entry, and shall provide for continued compliance with such requirements. Failure on the part of any water-right applicant or entryman to comply with such requirements shall render his application or entry subject to cancellation.

LANDS NOT SUBJECT TO RECLAMATION ACT.

SEC. 9. That in all cases where application for water right for lands in private ownership or lands held under entries not subject to the reclamation law shall not be made within one year after the passage of this act, or within one year after notice issued in pursuance of section four of the reclamation act, in cases where such notice has been heretofore given, the construction charges for such lands shall be five per centum each year until such application is made and an initial installment is paid.

WITHDRAWN LANDS SUBJECT TO ENTRY.

SEC. 10. That the act of Congress approved February eighteenth, nineteen hundred and eleven, entitled "An act to amend section five of the act of Congress of June twenty-fifth, nineteen hundred and ten, entitled 'An act to authorize advances to the reclamation fund and for the issuance and disposal of certificates of indebtedness in reimbursement therefor, and for other purposes,' be, and the same hereby is, amended so as to read as follows:

"SEC. 5. That no entry shall be hereafter made and no entryman shall be permitted to go upon lands reserved for irrigation purposes until the Secretary of the Interior shall have established the unit of acreage per entry, and water is ready to be delivered for the land in question or some part thereof and such fact has been announced by the Secretary of the Interior; *Provided*, That where entries made prior to June twenty-fifth, nineteen hundred and ten, have been or may be relinquished, in whole or in part, the lands so relinquished shall be subject to settlement and entry under the reclamation law."

SEC. 11. That whenever water is available and it is impracticable to apportion operation and maintenance charges as provided in section five of this act, the Secretary of the Interior may, prior to giving public notice of the construction charge per acre upon land under any project, furnish water to any entryman or private landowner thereunder until such notice is given, making a reasonable charge therefor, and such charges shall be subject to the same penalties and to the provisions for cancellation and collection as herein provided for other operation and maintenance charges.

ADMISSION OF PRIVATE LANDOWNERS TO NEW PROJECTS.

SEC. 12. That before any contract is let or work begun for the construction of any reclamation project hereafter adopted the Secretary of the Interior shall require the owners of private lands thereunder to agree to dispose of all lands in excess of the area which he shall deem sufficient for the support of a family upon the land in question, upon such terms and at not to exceed such price as the Secretary of the Interior may designate; and if any landowner shall refuse to agree to the requirements fixed by the Secretary of the Interior, his land shall not be included within the project if adopted for construction.

DISPOSITION OF EXCESS FARM UNITS.

SEC. 13. That all entries under reclamation projects containing more than one farm unit shall be reduced in area and conformed to a single farm unit within two years after making proof of residence, improvement, and cultivation, or within two years after the issuance of a farm unit plat for the project, if the same issues subsequent to the making of such proof; *Provided*, That such proof is made within four years from the date as announced by the Secretary of the Interior that water is available for delivery for the land; any entryman failing within the period herein provided to dispose of the excess of his entry above one farm unit, in the manner provided by law, and to conform his entry to a single farm unit shall render his entry subject to cancellation as to the excess above one farm unit; *Provided*, That upon compliance with the provisions of law such entryman shall be entitled to receive a patent for that part of his entry which conforms to one farm unit as established for the project; *Provided further*, That no person shall hold by assignment more than one farm unit prior to final payment of all charges for all the land held by him subject to the reclamation law, except operation and maintenance charges not then paid.

ACCEPTANCE OF THIS ACT.

SEC. 14. That any person whose land or entry has heretofore become subject to the reclamation law who, within the second year of the term of the period of payments provided by this act, shall within six months after the issuance of the first public notice hereunder affecting his land or entry, notify the Secretary of the Interior, in the manner to be prescribed by said Secretary, of his acceptance of all of the terms and conditions of this act, and thereafter his lands or entry shall be subject to all the provisions of this act.

SEC. 15. That the Secretary of the Interior is hereby authorized to perform any and all acts, and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this act into full effect.

SEC. 16. That from and after July first, nineteen hundred and fifteen, expenditures shall not be made for carrying out the purposes of the reclamation law except out of appropriations annually appropriated by Congress therefor, and the Secretary of the Interior shall, for the fiscal year nineteen hundred and sixteen, and annually thereafter, in the regular Book of Estimates, submit to Congress estimates of the amount of money necessary to be expended for carrying out any or all of the purposes authorized by the reclamation law, including the extension and completion of existing projects and units thereof and the construction of new projects. The annual appropriations made hereunder by Congress for such purposes shall be paid out of the reclamation fund provided for by the reclamation law.

Approved, August 13, 1914.



Homesteader in wheat field in Pablo district, Flathead project, Mont.

(38)



Picking pears, Grand Valley project, Colo.

(39)



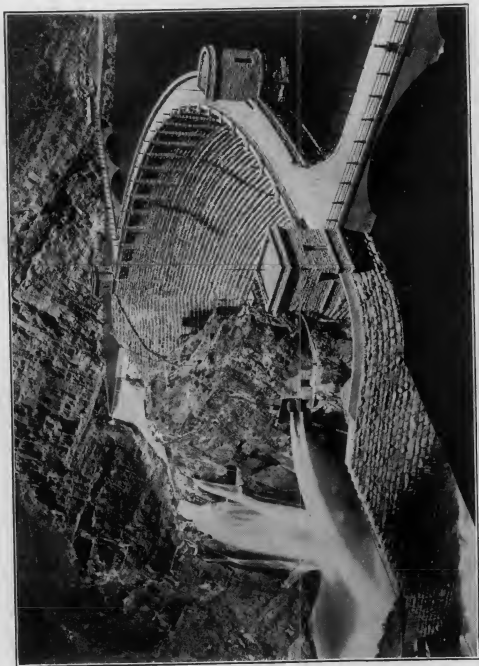
Homesteader in wheat field in Pablo district, Flathead project, Mont.

(38)



Picking pears, Grand Valley project, Colo.

(39)

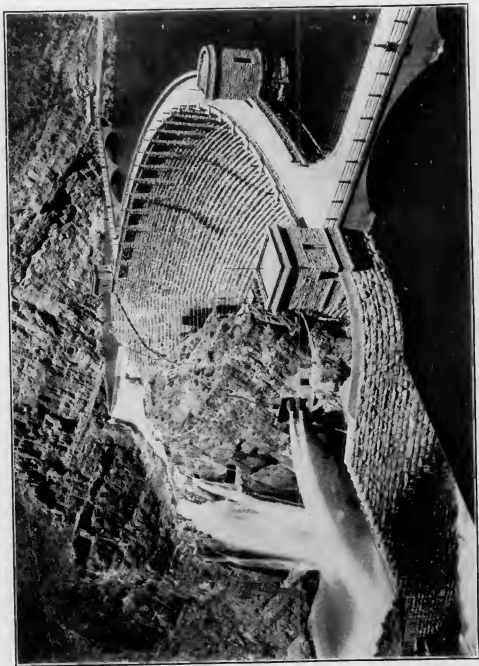


Roosevelt dam, Salt River project, Ariz.

(40)

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Roosevelt dam, Salt River project, Ariz.

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